TREE-RING CHRONOLOGIES IN SOUTH-CENTRAL ALASKA

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The function of tree-ring studies in Alaska has been to establish regional chronologies for various localities, to date wood from archaeological sites, and to interpret the climatic meaning of tree-rings.* These studies have been pursued in a restricted manner, due largely to the limited number of adequately sampled areas. The purpose of the present study is to define the characteristic ring features of living trees in a previously unsampled area, south-central Alaska, and to relate the findings to the existing ring chronologies.

In Alaska the one consistently datable species, white spruce *(Picea glauca)*, has been sampled from the northern interior region, the Noatak-

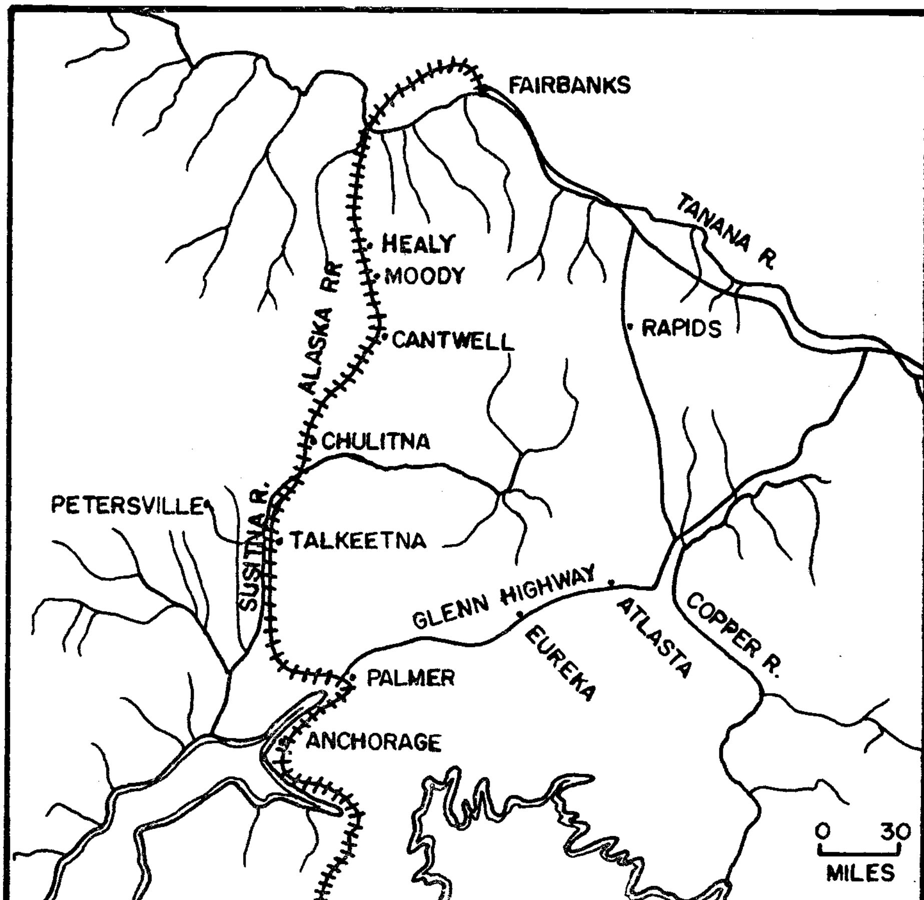

FIGURE 1. Map of south-central Alaska.

*There has been no attempt in this study to relate the principles and general techniques of tree-ring analysis to the growth indices. For a consideration of these, the reader is referred to the only definitive analysis of tree-ring principles as applied to Arctic America; Dendrochronology in Northern Alaska, by J. L. Giddings, Jr., *Univ. of Ariz. Bull.* 12, No. 4.

Kobuk area, and Seward Peninsula.[1] Chronologies were determined also for the lower Yukon, Copper, and Kuskokwim River areas,[2] while the current study delineates ring chronologies for the Susitna River drainage and adjacent areas of the Tanana and Copper River systems.

The white spruce sampled were growing in one general geographical region which contained varied ecological zones; the individual stands range from tree-line, at 2900 feet (all distances are approximate), to valley bottom at 350 feet. Collection sites were located in a roughly L-shaped area, with the community of Palmer as the axis, the north-south arm extending for 150 miles and the east-west arm for 110 miles (see Figure 1). All samples were collected in the fall of 1952[3] from points along the Alaska Railroad and the Glenn Highway. This is an area containing a relatively heavy human population; consequently many of the spruce have either been cut over or burned during the last fifty years, accounting for the short ring records of the trees in some stands.

The collection consists of one hundred and eighty spruce samples, all taken with the Swedish increment borer. Each sample was processed for analysis in the standard manner, i.e., surfacing the cores, visually selecting the cores with the greatest over-all year-to-year variation in ring thickness (which numbered forty-four specimens in this collection), measuring each ring in hundredths of a millimeter, plotting the measures on metric paper, comparing similar measured pieces in the same stand, and averaging the most sensitive individual pieces to form six regional groups (see Table 1). The groups were then compared with similarly processed samples from other Alaskan localities. A summary of the ecological position of the trees and other pertinent data for each group in this study follows.

Group I, Moody. This stand of white spruce is one mile northwest of the Alaska Railroad station of Moody on the north-eastern border of Mt. McKinley National Park. These trees grow at tree-line in a rugged mountain area along the upper Tanana River drainage and form a separate unit from the small, stunted, wind-contorted trees clinging precariously to the steep mountain sides and growing at the upper limit of the species. The stand is widely scattered on a well-drained, steep slope where there is a thin soil layer on top of the rocky glacial till; the ground cover includes mainly short grasses and scattered patches of willows. The region is subject to strong winds, which blow through the steep and narrow north-south pass, but the sampled trees are sheltered from the wind and are not noticeably abberant in their external growth characteristics. Each of the three individual measured trees from this group contains approximately 150 rings.

TABLE 1. Average ring widths of the six specimen groups in south-central Alaska. All figures given are in hundredths of a millimeter.

I. MOODY

	0	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
1840	19	28	33	36	35	31	31	32	37	32
1850	39	32	36	40	37	43	42	48	42	27
1860	22	18	20	25	25	22	18	21	17	17
1870	17	20	18	14	21	26	29	20	19	21
1880	19	19	21	11	18	17	18	20	18	13
1890	19	23	21	22	31	19	11	14	21	22
1900	24	23	17	19	18	20	13	18	28	32
1910	30	31	23	23	18	16	21	18	15	19
1920	28	27	19	27	16	22	17	19	29	28
1930	31	21	34	36	37	40	44	36	33	25
1940	33	21	26	45	40	49	51	48	48	51
1950	59	54	66	....	....	....	....	....	....	....

[1] J. L. Giddings, Jr., *University of Arizona Bulletin* 12, No. 4, 1941; *Tree-Ring Bulletin* 18: 2-6, 1951.

[2] W. H. Oswalt, *Tree-Ring Bulletin* 16: 26-30, 1950; *Tree-Ring Bulletin* 19: 5-10, 1952; *Anthropological Papers, University of Alaska* 2: 203-214, 1954.

[3] The collection of these tree-ring samples was made possible by a grant-in-aid from the University of Alaska. The funds were kindly made available to the writer by Dr. Ivar Skarland, Head, Department of Anthropology, of the same institution. The field collection was made with the assistance of James Van Stone; Dr. J. L. Giddings, Jr. and Mr. Terah L. Smiley read the manuscript and offered helpful criticisms.

II. Cantwell

	0	1	2	3	4	5	6	7	8	9
1760	....	....	46	49	41	39	47	47	40	46
1770	45	34	43	39	48	47	55	47	45	45
1780	38	40	32	29	23	27	28	29	24	27
1790	27	29	31	34	29	33	28	30	21	23
1800	26	30	39	44	28	23	30	24	28	22
1810	24	21	23	23	16	12	13	14	15	16
1820	15	16	13	17	14	12	10	13	15	19
1830	14	19	23	15	15	13	16	17	24	20
1840	19	21	25	25	26	17	18	19	22	19
1850	18	15	16	22	34	39	28	37	36	38
1860	33	41	43	39	37	41	34	46	42	34
1870	37	39	36	56	68	61	56	52	43	38
1880	43	46	48	42	40	41	44	33	42	36
1890	39	39	39	37	39	37	43	39	45	34
1900	28	28	28	32	29	31	36	29	33	28
1910	23	28	22	29	29	30	25	27	29	20
1920	27	24	21	24	20	20	19	23	21	26
1930	24	20	30	38	47	43	43	43	27	35
1940	27	31	30	38	36	37	40	38	52	40
1950	38	40	41	....	....	....	....	....	....	....

III. Chulitna

	0	1	2	3	4	5	6	7	8	9
1860	....	49	40	41	44	49	44	38	31	40
1870	48	42	48	46	42	47	49	31	24	33
1880	48	61	67	48	52	49	67	60	63	60
1890	74	63	61	64	57	47	53	48	41	46
1900	36	44	61	61	47	59	52	65	57	46
1910	37	32	31	39	37	53	40	56	53	45
1920	48	50	47	55	51	48	46	48	47	49
1930	42	31	60	60	46	52	45	27	27	33
1940	27	37	44	46	41	44	45	48	29	29
1950	29	36	33	....	....	....	....	....	....	....

IV. Talkeetna

	0	1	2	3	4	5	6	7	8	9
1850	....	....	....	....	114	111	115	105	113	119
1860	107	85	122	108	102	131	122	91	81	77
1870	85	121	113	96	169	91	106	76	81	57
1880	72	64	82	83	74	79	105	101	62	96
1890	77	58	69	91	60	48	58	52	44	44
1900	47	50	45	46	43	52	41	65	47	43
1910	33	30	37	45	50	108	73	78	71	66
1920	71	70	52	64	51	84	94	81	102	87
1930	116	94	129	110	90	84	77	70	96	75
1940	75	99	107	121	134	50	31	42	65	85
1950	93	95	96	....	....	....	....	....	....	....

V. Eureka

	0	1	2	3	4	5	6	7	8	9
1790	....	48	54	57	72	62	45	59	48	45
1800	36	58	45	43	37	34	37	36	43	35
1810	39	47	45	45	34	35	43	31	35	48
1820	40	40	33	47	37	33	29	33	45	50
1830	31	39	45	47	34	30	41	33	39	28
1840	33	36	35	39	47	31	40	39	53	36
1850	39	41	35	33	39	37	26	37	49	44
1860	41	37	42	45	50	47	45	52	37	34
1870	39	30	46	40	43	49	45	31	33	31
1880	33	40	37	36	46	39	45	31	49	40
1890	38	37	33	35	37	35	40	36	34	34
1900	27	29	32	27	20	33	30	25	24	23
1910	22	25	19	24	17	22	15	18	25	10
1920	23	20	18	20	19	12	14	18	13	15
1930	13	14	14	19	18	18	20	19	18	25
1940	20	25	22	28	26	23	22	25	40	23
1950	27	21	20	....	....	....	....	....	....	....

VI. Atlasta

	0	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
1780	....	64	56	45	50	56	53	48	46	40
1790	39	69	62	70	87	83	72	73	57	53
1800	55	74	73	65	50	55	50	31	41	35
1810	42	37	36	36	31	34	41	33	48	48
1820	55	52	40	44	35	37	31	37	38	43
1830	35	34	46	42	40	39	39	36	40	26
1840	32	38	50	41	53	39	37	34	43	32
1850	32	32	30	31	37	35	30	39	40	41
1860	43	35	35	41	40	35	22	36	26	26
1870	27	29	30	31	35	37	35	27	29	24
1880	29	35	38	30	38	27	23	28	23	21
1890	24	25	26	27	33	27	25	30	27	25
1900	20	20	27	22	19	20	19	19	22	19
1910	16	19	17	25	21	24	18	19	16	12
1920	19	17	17	19	16	18	15	17	19	20
1930	19	19	17	19	19	22	24	21	19	22
1940	15	18	19	21	20	20	21	20	31	19
1950	19	21	22	....	....	....	....	....	....	....

Group II, Cantwell. This tree-line stand is two miles southeast of the Alaska Railroad settlement of Cantwell in the upper Tanana River drainage. It is located on a well-drained, gently sloping hillside. Moss and grasses grow in the thin soil layer on top of the glacial till. The A.D. 1783 "faint latewood" growth is apparent in four of a possible four specimens. The five trees comprising the group averaged 160 rings each.

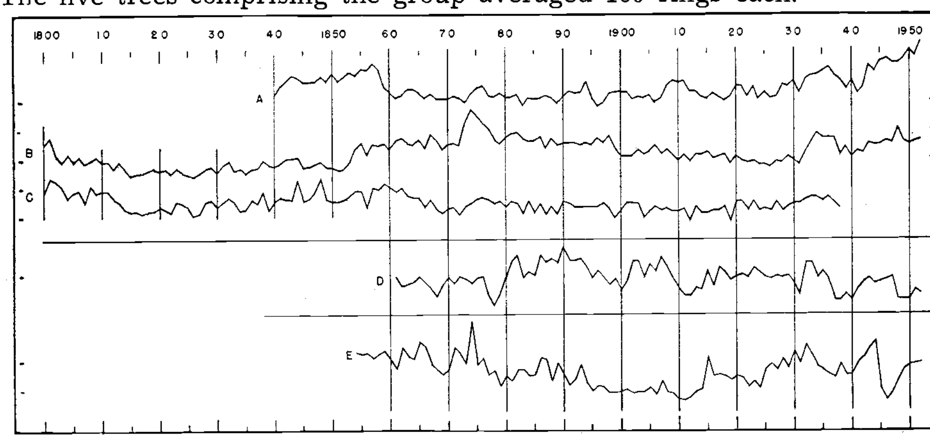

Figure 2. Group means for the Moody (A) and Cantwell (B) stands compared with Giddings' Alaska Range mean (C). The Chulita (D) and Talkeetna (E) groups follow.
Figures 2 and 3 are plotted at one-half the vertical scale of the other figures.

Group III, Chulitna. The four samples, averaging 110 rings each, are from a widely scattered stand at tree-line, located northeast of the Alaska Railroad station of Chulitna in the upper Susitna River drainage. Tree growth has been visibly affected by a prevailing northerly wind sweeping through the narrow pass; the north sides of the trunks have fewer limbs than do the south sides. The stand is growing on a small plateau area, with moss and grasses as the principal forms of undercover.

Group IV, Talkeetna. This valley bottom stand, four miles from the west bank of the Susitna River on the Peterville Road, is located on the northern crest of a low ridge at about 350 feet above sea level. The compact cluster of trees is growing on a thick layer of silty soil, with a moss and willow ground cover. The three Talkeetna samples used had slightly less than a hundred rings each and represent the longest ring sequences in

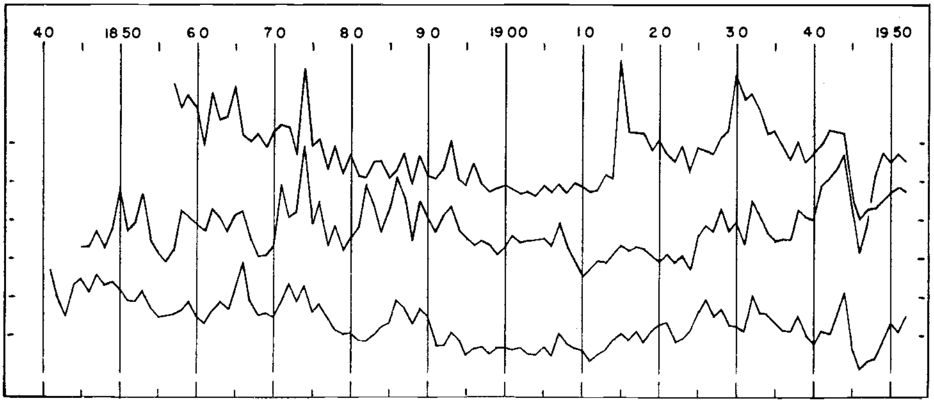

FIGURE 3. The plotted measures of three individual trees from the Talkeetna stand.

an original sampling of twenty cores. Measures of the individual specimens are illustrated in Figure 3.

Group V, Eureka. The four measured trees of this group, averaging 180 rings, are plotted in Figure 5. Samples were taken over an area nearly two miles in length from this widely scattered stand located near the upper forest border. The ground cover consisted mainly of a thin moss layer on silty soil. The location is at the western headwater area of the Copper River, 14 miles east of the Eureka Roadhouse on the Glenn Highway. While these trees do not have an extreme range in individual ring variation, they crossdate among themselves. One of a possible two samples has the distinctive A.D. 1783 "faint latewood" in evidence.

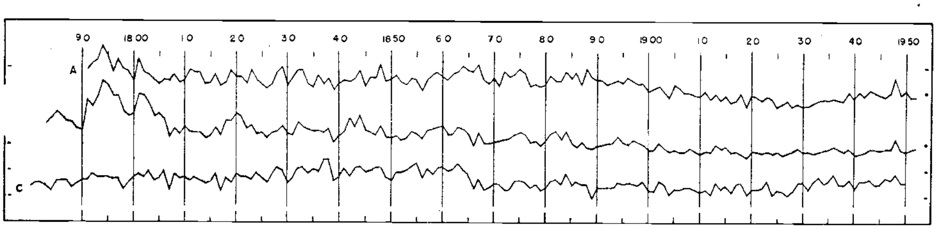

FIGURE 4. Group means for the Eureka (A) and Atlasta (B) stands compared with a mean for the Copper River (C).

Group VI, Atlasta. The four trees, averaging 175 rings each, represent a widely scattered stand 1,000 feet above sea level and in a marshy area with a thick ground cover of moss. This group is in the upper region of the Copper River drainage along the Glenn Highway near Atlasta Roadhouse. One of a possible three trees in this stand has the distinctive A.D. 1783 "faint latewood" present.

The individual ring widths for all the sampled trees range from 0.05 to 1.99 mm., and the patterns of large and small rings are traceable from tree to tree in the same stand. This consistency of ring pattern is commonly referred to as "local crossdating" and is graphically illustrated in Figures 3 and 5 for the Talkeetna and Eureka groups. As mentioned previously, after the similarity of tree-ring patterns had been established for a stand, the individual ring measures for each tree were combined into stand or group averages which could be compared with one another as well as with previously published data of a like nature. There is a graphic representation of the groups in Figures 2 and 4; the exact year-to-year ring averages for each group appear in Table 1. A visual com-

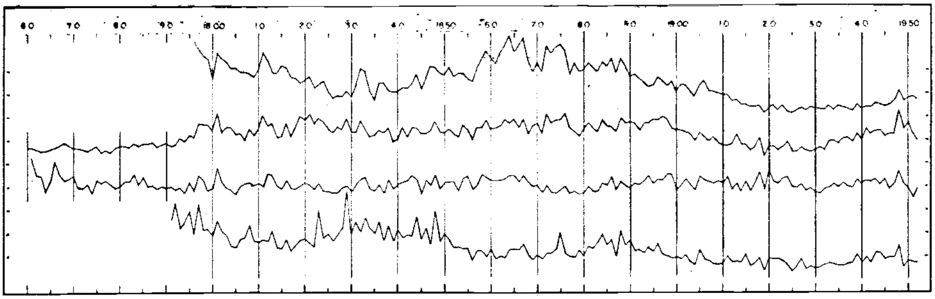

FIGURE 5. The plotted measures for four individual trees from the Eureka stand.

parison indicates the Cantwell, Eureka, and Atlasta groups have the most features in common, i.e., patterns of large and small rings, while the Moody, Chulitna, and Talkeetna groups vary from the former groups as well as among themselves.

A pertinent problem is the meaning of the above ring similarities and variances when related to previously published Alaskan tree-ring chronologies and to the local climatic picture. Visual comparison with other Alaskan chronologies demonstrates that the Cantwell, the Eureka, and the Atlasta groups have the ring characteristics of the widespread ring sequence designated "Series A Dating" by Giddings.[4] A further comparison indicates that the Eureka and Atlasta groups are most similar to Series A Dating as it has been defined from the Copper River.[5] The similarities in ring thickness make it reasonable to infer that the factors which influence the proportion of tree growth are essentially the same in the above localities. It should be noted also in this connection that mountains ranging in elevation from 5,000 to 15,000 feet separate the Alaska Range spruce trees from those growing in the Susitna and Copper River drainages. Giddings has demonstrated that there is a direct positive correlation between a small ring in a tree-line spruce and a low temperature for June and July.[6]

The three remaining groups, Moody, Chulitna, and Talkeetna, must be discussed separately because of the nature of their particular ring records. The Moody group, geographically situated between the Cantwell and Alaska Range groups,[7] has few diagnostic rings comparable to either of the latter (Figure 2). The divergence is undoubtedly related to the ecological position of the Moody stand which is in a narrow wind-swept pass, contrasting sharply with the open hillsides on which the Alaska Range and Cantwell stands are found. Essentially the same situation exists at Chulitna, where the trees are in the same type of wind-swept pass as well as being on a moist plateau. Again, the Chulitna ring pattern is local and has few rings diagnostic of Series A Dating.

The Talkeetna spruce are perhaps the most interesting of the entire series. These trees, growing near valley bottom, crossdate among themselves. Valley bottom crossdating of the type recorded at Talkeetna has been reported from the Fort Yukon-Stevens Village area of northern interior Alaska where it is termed "Series B Dating".[8] However, there is no over-all correspondence between the Talkeetna ring patterns and those of Series B Dating. It is possible that more extensive sampling of white spruce in the Talkeetna area would reveal that this distinctive cross datable ring sequence is to be found over a wide area.

[4] J. L. Giddings, Jr., *University of Arizona Bulletin* 12, No. 4, pp. 52-74, 1941.
[5] W. H. Oswalt, *Tree-Ring Bulletin* 19: 10, 1952.
[6] J. L. Giddings, Jr., *Tree-Ring Bulletin* 9: 26-32, 1943.
[7] J. L. Giddings, Jr., *University of Arizona Bulletin* 12, No. 4, Table 4, 1941.
[8] *Ibid.*, pp. 20-26.

Summary and conclusions. The analysis of a selected sample of white spruce cores from south-central Alaska demonstrates that two chronologies exist: the widespread Series A Dating and the purely local chronology. The former ring chronology is characteristic of spruce growing at tree-line on most mountain sides in interior and south-central Alaska as well as at tree-line on the Arctic coast where the tundra and taiga meet. Thus, in sensitive trees similar ring patterns may be found as much as 600 miles apart. Perhaps still more remarkable is the fact that, judging from a preliminary statement by Giddings,[9] spruce from the western shore of Hudson Bay have chronology characteristics like those of Series A Dating. The localized chronologies are probably linked to local microclimatic factors, and may, upon a refinement of interpretive techniques, offer an index to past localized summer temperatures.

[9] J. L. Giddings, Jr., *Tree-Ring Bulletin* 20: 24, 1954.

THE TREE-RING SOCIETY

October, 1958 Meetings

At a business meeting of the Tree-Ring Society on Saturday, October 11, 1958, members present decided to continue the Society and the publication of the Tree-Ring Bulletin. This decision was made after lengthy discussion regarding the problem and the reading of letters received from the membership at large.

Dr. Emil W. Haury was appointed to head a committee to draw up a slate of candidates for the various offices; election to be held at the next called meeting. This meeting was held at the Arizona State Museum on Tuesday, October 21, 1958. Officers elected at this meeting were: *President* – Dr. John C. McGregor, Department of Sociology and Anthropology, University of Illinois, Urbana, Illinois; and *Secretary* – Mr. Charles W. Ferguson, Department of Watershed Management, University of Arizona, Tucson, Arizona.

The newly-elected officers, according to Society by-laws, have appointed as editor and assistant editor of the Tree-Ring Bulletin: *Editor* – Mr. Bryant Bannister, Curator of Archaeological Collections, Laboratory of Tree-Ring Research, University of Arizona; and *Assistant Editor* – Dr. J. L. Giddings, Director of the Haffenreffer Museum of the American Indian, Brown University, Bristol, Rhode Island.

Charles W. Ferguson,
Secretary